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Original article

Effect of Vegetative Herbicides on the Weed Infestation and the Productivity of Common Winter Wheat (*Triticum aestivum* L.)

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Abstract

The aim of this investigation was to determine the effect of the application of vegetative herbicides on the weed infestation and the productivity in cultivars common winter wheat. The investigations were carried out during 2018 – 2021 at Dobrudzha Agricultural Institute – General Toshevo (DAI). The following herbicides were used: Ergon WG (50 g/ha), Starane Gold (1800 ml/ha), Biatlon 4D+Desh (50g/ha+500ml/ha) and Korelo Duo+Das Oil (260.5 g/ha+500ml/ha) from the group of sulfunylureas with various mechanism of action. The preparations were applied at stage 29 and 37 (according to Zadoks) of three cultivars common winter wheat, Rada, Kosara and Pchelina. The herbicide effect was determined by the quantitative weight method and evaluated by the EWRS scale. Four-factor dispersion analysis was applied. The factors year conditions, cultivar, herbicide and stage were followed. Regardless of the cultivars and the stage of treatment, Starane gold had highest efficiency (100%) against the following investigated weeds: *Sinapis arvensis* L., *Matricaria chamomilla* L., *Anthemis arvensis* L., *Galium tricorne (Stock.)*, *Consolida orientalis (J. Gay)* and *Cirsium arvensis* L. Ergon WG, Biatlon 4D+Desh and Korelo Duo+Das Oil had 100% efficiency against *Sinapis arvensis* L., *Matricaria chamomilla* L., *Anthemis arvensis* L. and *Cirsium arvensis* L. and lower effect (90-94%) on G*alium tricorne (Stock), Consolida orientalis (J. Gay)*. The factors with highest strength of effect were the year conditions (60%) and the used cultivar (30%).

Keywords: Common Winter Wheat, Herbicides, Weed Infestation, Efficiency, Selectivity, Productivity.

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INTRODUCTION

Weeds limit yield potential in arid region because they increase evapotranspiration and compete with cereals plants for limited soil moisture (Donald and Easten, 1995), water and light, resulting in grain yield reduction amounted to 7% and 92% and in serious cases may lead to complete crop failure (Abdul-Khaliq and Imran, 2003). Use of aggressive cultivars can be effective cultural practice for weed growth suppression (Seavers and Wright, 1999). According to Bussan et al. (1997), the competitive ability of crop can be expressed in two ways. First is the ability of the crop to compete with weeds, reducing weed seed and biomass production. The second possibility is having crop tolerate competition from weeds, while maintaining high yields. Cardina (1995) concluded that more competitive cultivars are not higher yielding. The difference in the ability of cultivars to suppress weed than other might be due to differential rooting patterns, higher leaf area, tillering capacity and vegetative growth habit (Seavers and Wright, 1999).

Available literature includes quite a few data showing expressed susceptible of the weeds: *Chenopodium album, Cirsium arvense, Consolida orientalis, Delphinium consolida, Convolvulus arvensis, Fumaria officinalis, Galium aparine, Lathyrus tuberosus, Sinapis arvensis, Stellaria media, Veronica hederifolia* and *Viola tricolor* to amidosulfuron (D´Souaza et al., 1993), iodosulfuron (Hacker et al. 1999), amidosulfuron+iodosulfuron (Malidža, 1999**)**, and florasulam (Thompson et al., 1999).

MATERIALS and METHODS

The investigations were carried out during 2018 – 2021 at Dobrudzha Agricultural Institute – General Toshevo (DAI). The fired trial was designed according to the block method in three replications, the size of the trial area being 10.5 m^2. Two check variants were involved: K_1 – weed-free variant manually cleaned till stage heading of wheat, and K_2 – check variant infested with weeds till the end of the crops' vegetation period.

The following herbicides were used: Ergon WG (metsulfuron-metil+tifensulfuron-metil) - 50 g/ha, Starane Gold (florasulam+fluroksipir) - 1800 ml/ha, Biatlon 4D+Desh (tritosulfuron+florasulam) - 50 g/ha+500 ml/ha, Korelo Duo+Das Oil (piroksulam+florasulam+klokvintotset-meksil) – 260.5 g/ha+500 ml/ha. The preparations were applied at stage "end of tillering", "stage 29" and stage "emergence of flag leave", "stage 37" according to Zadoks et al., (1974) of three winter wheat cultivars Rada, Kosara and Pchelina.

Before planting of wheat, artificial background of weed infestation was created using the most widespread weeds in the region of DAI – General Toshevo: the annual broad-leaf weeds ivy-leaved speedwell- *Veronica hederifolia* L., wild mustard - *Sinapis arvensis* L., cleavers - *Galium tricorne Stok*, the German chamomile - *Matricaria chamomila* L., field chamomile - *Anthemis arvensis* L., Royal

knight's spur- *Consolida orientalis J. Gay*; and the perennial broad-leaf weeds creeping thistle - *Cirsium arvense* L. *Scop.* and field bindweed- *Convolvulus arvensis* L. Weed density was measured quantitatively per unit area by species using ¼ frame in four replications prior to introduction of herbicides.

The herbicide efficiency was estimated 25-30 days after the use of the preparations according to species, by amount and weight, using ¼ frame in four replications, measuring the weight of the weeds in fresh and dry condition. The effect was evaluated according to the 9-degree scale of EWRS for reading of the herbicide activity and selectivity, 1 corresponding to 100 % efficiency of the preparation, without symptoms of phytotoxicity on the cultural plants; and 9 corresponding to 29.9 % - 0 % effect of the preparation and complete perishing of the plants (Table 1).

Table 1. Herbicide activity and selectivity according to 9-degree scale of EWRS

Rank	Herbicide efect %	Damage symptoms	General evaluation
1	100	No symptoms – healthy plants	Excellent
2	99.9-98	Very weak symptoms – slight stunt effect	Very good
3	97.9-95	Weak but discernable symptoms	Good
4	94.9-90	Better expressed symptoms (eg. chlorosis) which do not affect yield	Satisfactory
5	89.9-82	Thinning of the crop, strong chlorosis or stunt. Lower yield expected	Indefinitely
6	81.9-70	Heavy damage or perishing of plants	Unsatisfactory
7	69.9-55	Heavy damage or perishing of plants	Poor
8	54.9-30	Heavy damage or perishing of plants	Very poor
9	29.9-0	Heavy damage or perishing of plants	Extremely poor

Cultivar Rada is characterized with 90 cm stem height, high resistance to lodging and spike which is awnless, with high number of grains and complete resistance to lodging. The cultivar is medium early, with very good cold and winter resistance and good drought tolerance.

Cultivar Kosara has stem height 75-90 cm and possesses high resistance to lodging and good number of productive tillers. The cultivar is awnless and completely resistant to shedding. It is medium early, with good cold and winter resistance and very good drought tolerance.

Cultivar Pchelina is 85-100 cm high, with very good resistance to lodging and very good number of productive tillers. The spike is awned and highly resistant to shedding. The cultivar is medium early and tolerant to drought.

Meteorological characterization during the period of investigation

In 2018/2019 harvest year, the presented meteorological parameters - temperature and precipitation, no significant differences were observed compared to the reported long-year period (1960-2010) (Fig. 1). The meteorological situation was within optimal limits. Under optimal conditions, the plants have entered the development stages for the respective year.

In 2019-2020 crop year, regarding the precipitation parameter, extreme values were recorded in June of 192.2 mm. Regarding the temperature parameter, no significant differences were observed with those for the long-year period (1960-2010).

In 2020/2021, regarding the temperature parameter, no significant differences were observed with those for the long-year period (1960-2010). Significant amounts of precipitation were reported in the months of January 2021-109.7 mm and in June 2021-162.7 mm. The reported rainfall during this period is a prerequisite for very good development and growth of the tested varieties.

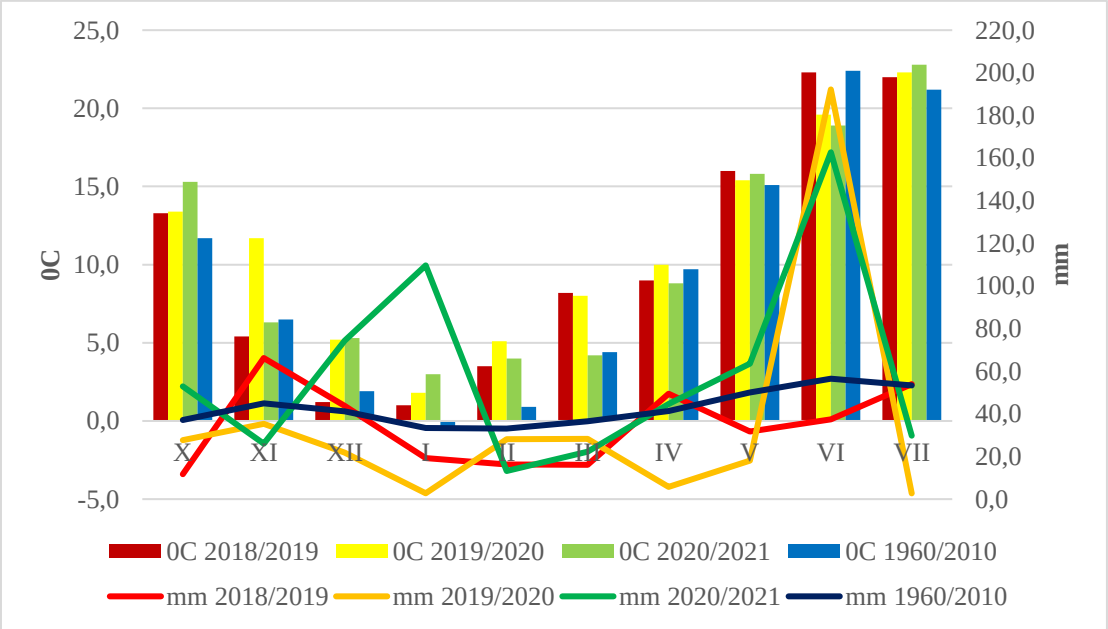

Figure 1. The air temperature and rainfull in the growing season of winter wheat, accordimg to Meteorological Station at DZI - General Toshevo, 2018-2021

Statistical Analysis

Four-factor dispersion analysis was applied. The factors year conditions, cultivar, herbicide and stage of treatment were followed. The data were analysed by statistic program SPSS 13.0.

RESULTS and DISCUSSION

In 2018 - 2021, after treatment at" stage 29" and "stage 37" of cultivar Rada, Kosara and Phelina, the weed composition was read using the quantitative weight method (Table 2). 25-30 days after the application of herbicides, partial and full action of the used products was observed. The cereals crops were the most resistant and the weeds – the most susceptible to the herbicides. Single species from the above were determined. In some variants newly emerging plants of field bindweed were found. The dry matter weight of the weeds was minimal in individual variants of the trial as a result from the very good herbicide effect.

Very high efficiency was registered after treatment at stage "29" and "37"on the herbicides metsulfuron-metil+tifensulfuron-metil, tritosulfuron + florasulam, piroksulam + florasulam + klokvintotset-meksil (100 % - rank 1 according to the scale of EWRS) in wild mustard, cleavers, field chamomile, creeping thistle. The same herbicides had high herbicide effect (90-94% – rank 4 according to scale EWRS) at the same stages of application against cleavers and Royal knight's spur. Florasulam+fluroksipir demonstrated very high herbicide action (100%– rank 1 according to the scale of EWRS) against wild mustard, cleavers, German chamomile, field chamomile, Royal knight's spur and creeping thistle. The description of the efficacy of the tested herbicides against the specified weeds was the same for the three wheat cultivars and for the entire study period. During the investigation years, the density of ivy-leaved speedwell after treatment with tested herbicides was not determined because its vegetative growth was over by the time of reading the results.

Table 2. Efficacy of some herbicides against annual and perennial broadleaf weeds at cultivars Rada, Kosara, Pchelina according to the 100% visual scale of EWRS, 2018-2021

Variants/Weeds	***S. arvensis***	***G.tricorne***	***M. chamomilla***	***A. arvensis***	***C. orientalis***	***C. arvense***
metsulfuron-metil+tifensulfuron-metil-50g/ha	100	90	100	100	90	100
florasulam+fluroksipir-1800 g/l	100	100	100	100	100	100
tritosulfuron+florasulam +Desh - 50g/ha+500ml/ha	100	90	100	100	90	100
piroksulam+florasulam+klokvintotset-meksil+Das Oil-260.5ml/ha+500ml/ha	100	90	100	100	90	100

During 2018 - 2021, meteorological conditions were haracterized with hightest streight of effect (60%), on the parameter productivity. It was followed on factor cultivar. Lower part of variation were factors – stage of treatment and applied herbicide (Fig.2).

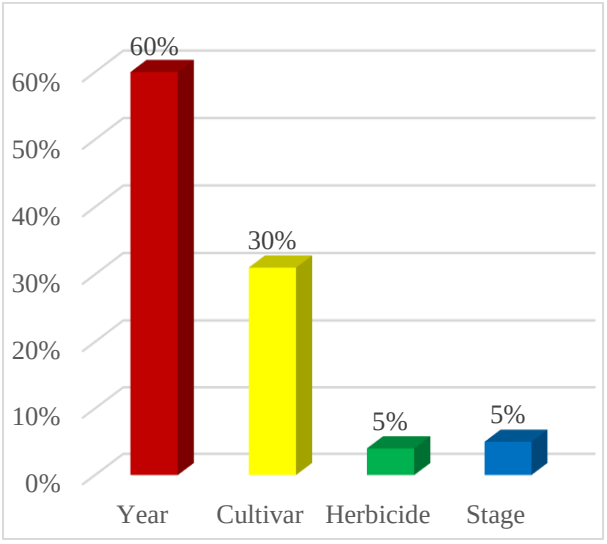

Figure 2. Streight of factors' effect on the productivity, 2018-2021.

Conclusion

Regardless of the cultivars and the stage of treatment, florasulam+fluroksipir had highest efficiency (100%) against the following investigated weeds: *Sinapis arvensis* L., *Matricaria chamomilla* L., *Anthemis arvensis* L., *Galium tricorne (Stock.), Consolida orientalis (J. Gay)* and *Cirsium arvensis* L. Metsulfuron-metil + tifensulfuron-metil, tritosulfuron + florasulam and piroksulam + florasulam + klokvintotset-meksil had 100% efficiency against *Sinapis arvensis* L., *Matricaria chamomilla* L., *Anthemis arvensis* L. and *Cirsium arvensis* L. and lower effect (90-94%) on *Galium tricorne (Stock), Consolida orientalis (J. Gay).*

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